Brief Communications

Thyroid dysfunction after pediatric cardiac surgery

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Plasma protein loss from prolonged chest tube drainage in pediatric patients after surgery can cause hypoalbuminemia and low levels of antithrombin (AT) III and immunoglobulins (Igs). We report 5 cases of hypothyroidism possibly secondary to loss of thyroid binding globulin from prolonged chest tube drainage.

Clinical Summary

Patient 1, a 3.23-kg girl born with pulmonary and aortic stenosis, atrial septal defect (ASD), and ventricular septal defect (VSD), underwent aortic and pulmonary valvotomies, ASD closure, and patent ductus arteriosus ligation on day of life (DOL) 2. Chest tube drainage was greater than 100 mL/d until postoperative day (POD) 108. To decrease lymphatic drainage, thoracic duct ligation was performed on POD 33, and somatostatin (7 μg · kg · d) was administered on PODs 37 to 41. Thyroid function on newborn screening was normal. On POD 8, the thyroid stimulating hormone (TSH) level was 15.18 mU/L (normal value 0.4-5.0 mU/L), and the free thyroxine level was 0.95 ng/dL (normal value 0.9-2.6 ng/dL). TSH levels decreased to 8.57 mU/L by POD 39 (free thyroxine level 1.39 ng/dL) and 4.08 mU/L by POD 95 (free thyroxine level 0.72 ng/dL). Because the levels of serum IgG and ATIII were low, the patient received serial intravenous (IV) Ig and ATIII replacement while chest tubes were present. The patient died on POD 108 from acute renal failure and sepsis.

Patient 2, a 3.56-kg boy born with D-transposition of the great arteries, ASD, and VSD, underwent complete repair on DOL 4. Chest tube output greater than 100 mL/day occurred until POD 111. To decrease lymphatic drainage, the thoracic duct was ligated on POD 81, and he received somatostatin (5-10 μg · kg · d) on PODs 43 to 47. Peritoneal dialysis was initiated on POD 14 for renal failure and was continued until POD 143. On POD 63, the TSH level was 4.27 mU/L, and the free thyroxine level was 0.91 ng/dL. On POD 86, the TSH level was 6.85 mU/L, and the triiodothyronine level was 104 ng/dL (normal 85-250 ng/dL). Synthroid therapy of 30 μg/d was administered IV on PODs 97 to 143. The TSH level was 0.44 mU/L on POD 105. Because the levels of IgG and ATIII were low, the patient received serial IVIg and ATIII replacement. The patient died on POD 143 from xanthomonas peritonitis.

Patient 3, a 2.95-kg girl born with total anomalous pulmonary venous connection and ASD, underwent complete repair on DOL 2. Chest tube output was greater than 100 mL/d until POD 58. She underwent thoracic duct ligation on POD 29 to decrease lymphatic drainage and had peritoneal dialysis on PODs 33 to 47 for renal failure. The TSH level was 1.02 mU/L (free thyroxine 1.19 ng/dL) on POD 9, and the free thyroxine level was 1.08 ng/dL on POD 24. The TSH level was 5.41 mU/L (free thyroxine 0.5 ng/dL) on POD 43, and the TSH level was 8.24 mU/L on POD 45. Synthroid therapy at 25 μg/d enterally was initiated on POD 45 and continued until POD 170. TSH levels ranged from 1.01 to 3.34 mU/L, and free thyroxine levels ranged from 0.67 to 2.88 ng/dL while thyroid hormone was administered. On POD 177, the TSH level was 3.56 mU/L, and the free thyroxine level was 0.87 ng/dL. Because the levels of ATIII and serum IgG were low, the patient received serial fresh frozen plasma and IVIg replacement until the chest tubes were removed. The patient survived and has not required any subsequent thyroid hormone supplementation.

Patient 4, a 4.45-kg girl born with hypoplastic right ventricle, ASD, VSD, and small tricuspid valve, underwent VSD closure and ASD snare on DOL 123. Chest tube output was greater than 100 mL/d until POD 58. To decrease lymphatic drainage, thoracic duct ligation

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TABLE 1. Serum protein levels before replacement

Patient number	TSH before synthroid replacement (mU/L)	Free thyroxine before synthroid replacement (ng/dL)	ATIII level before replacement (%)	IgG level before IVIg replacement (mg/dL)
1	NA	NA	68 (14)	46 (8)
2	6.84 (87)	0.91 (63)	39 (25)	95 (31)
3	8.24 (45)	0.50 (43)	60 (9)	274 (15)
4	0.60 (17)	0.72 (17)	38 (8)	307 (8)
5	19.32 (4)	0.92 (4)	37 (4)	NA

IVIg, Intravenous immunoglobulin; *TSH,* thyroid stimulating hormone; *AT,* antithrombin; *Ig,* immunoglobulin; *NA,* not available. Parentheses delineate days postoperatively. Normal values: TSH (0.4–5.0 mU/L); free thyroxine (0.9–2.6 ng/dL); ATIII chromogenic $>$ 90%; IgG (240–870 mg/dL).

was performed on POD 44. Because the levels of ATIII and IgG were low, the patient received serial ATIII and IVIg replacement until the chest tubes were removed. The TSH level was 3.74 mU/L (free thyroxine 0.84 ng/dL) on POD 8, and the TSH level was 0.6 mU/L (free thyroxine 0.72 ng/dL) on POD 17. Synthroid therapy at 25 μg/d enterally was initiated on POD 17 and continued until POD 114. While the patient was receiving thyroid hormone replacement, TSH levels ranged from 0.61 to 3.63 mU/L and free thyroxine levels ranged from 0.84 to 1.77. After discontinuation of thyroid hormone replacement, TSH levels have ranged from 3.47 to 7.42 mU/L, and free thyroxine levels have ranged from 1.65 to 2.11 ng/dL. The last measurement of thyroid hormone levels on POD 184 showed a TSH level of 4.23 mU/L and a free thyroxine level of 1.70 ng/dL. The patient survived and has not required any subsequent thyroid hormone supplementation.

Patient 5, a 2.83-kg term boy born with DiGeorge syndrome, Tetralogy of Fallot, and absent pulmonary valve, underwent Tetralogy of Fallot repair and placement of a pulmonary valve allograft on DOL 15. At the time of surgery, he was found to have a large chylous effusion. Chest tube output was greater than 100 mL/d until POD 24. To decrease lymphatic drainage, thoracic duct ligation was performed on POD 18. Newborn screening was performed before 24 hours of life, and the TSH level was 53.3 mU/L. On POD 4, the TSH level was 19.32 mU/L and the free thyroxine level was 0.92 ng/dL. Synthroid therapy at 25 μg/d either IV or enterally was initiated on POD 5 and continued until death occurred on POD 56 from renal and respiratory failure. Because the levels of ATIII were low, the patient received serial fresh frozen plasma replacement.

Discussion

Prolonged chest tube drainage can be an important issue after pediatric cardiac surgery. Loss of clotting factors such as ATIII in the effluent can lead to hypercoagulability and thrombosis.[1] Loss of Ig can lead to increased risk of infection and has been reported in pediatric patients after cardiac surgery.[2] We report here for the first time that thyroid function seems to be adversely affected by prolonged chest tube drainage.

In our case series, large amounts of chest tube output ($>$100 mL $\cdot$ kg $\cdot$ d) for a sustained period of time ($>$10 days) likely led to deficits of ATIII, IgG, and thyroid hormone secondary to the loss of thyroid-binding globulin. In our patient population, ATIII deficiency occurred in all 5 patients and IgG deficiency occurred in 4 patients (patients 1-4). On average, ATIII deficiency developed on POD 11, IgG deficiency occurred on POD 15, and clinical evidence of hypothyroidism was evident on POD 31 (Table 1). Transient secondary hypothyroidism is well described in pediatric patients after cardiac surgery and is thought to be secondary to suppression of the hypothalamic-pituitary-thyroid axis secondary to critical illness with resolution within 1 week postoperatively.[3] Except for possibly patient 4, our patients developed thyroid dysfunction through a different mechanism because they presented with elevated TSH levels and required therapy until death or until well after removal of their chest tubes. The condition is not permanent. All of the survivors did not require thyroid hormone replacement after its initial discontinuation, and patient 1 recovered without treatment. The development of hypothyroidism postoperatively may be exacerbated by neonatal hypothyroidism. Patient 5 did have a borderline elevated TSH level (53.3 mU/L) on newborn screening, which was performed before 24 hours of life and not repeated. Patient 5 also had a large chylous effusion found perioperatively, which may have been congenital. A correlation between congenital hypothyroidism and pericardial effusion has been previously reported.[4]

A number of postoperative factors, including the use of peritoneal dialysis, thoracic duct ligation, albumin or fresh frozen plasma replacement, and somatostatin to decrease lymphatic drainage, may have affected the course of the development of postoperative hypothyroidism and need to be further analyzed in a controlled fashion in future studies. The removal of peritoneal fluid by dialysis may have contributed to the development of hypothyroidism in patients 2 and 3. The use of somatostatin in patients 1 and 2 to decrease chest tube output had no discernible effect on thyroid function.

The development of hypothyroidism in the patients in our case series was probably secondary to loss of thyroid-binding globulin in chest tube output. This mechanism is similar to what has been reported in patients with congenital nephrotic syndrome in whom resolution of clinical hypothyroidism has been reported after bi-

lateral nephrectomy.[5] To show this decisively, future studies should quantitate the amount of thyroid-binding globulin in pleural fluid.

Conclusion

When chest tube drainage leads to loss of Ig and ATIII, it is important to document that thyroid function is normal. Although the mechanism by which hypothyroidism occurs is not conclusively proven, thyroid hormone replacement may be necessary in instances in which prolonged chest tube drainage occurs.

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Stage III empyema caused by *Actinomyces meyeri:* A plea for decortication

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Actinomycosis is a rare infectious disease caused by *Actinomyces* species, a genus of anaerobic gram-positive bacillus. *Actinomyces* organisms are saprophytes of the human digestive tract and are very sensitive to penicillin. Thoracic actinomycosis represents 15% to 20% of cases[1-4] with pleural effusion in only 20% of intrathoracic affection.[1,4,5] The usual clinical picture is that of a pleural effusion or pleural empyema together with a parenchymatous infection. We report a case of pleural effusion caused by *Actinomyces meyeri* without pulmonary involvement that failed to respond to chest tube drainage and antibiotherapy.

Clinical Summary

A 64-year-old woman was admitted with a history of fever and a dry cough associated with asthenia, weight loss, and exertional dyspnea. There was no previous medical history except for smoking and alcohol abuse. Laboratory studies showed a hemoglobin value of 9.9 g/100 mL, a hematocrit value of 25%, a leukocyte count of 13,200/mm^3, and a sedimentation rate of greater than 120 mm/h. Hemocultures were sterile, and the result of an HIV test was negative. A chest radiograph showed a massive left pleural effusion (Figure 1). Chest tube drainage was performed, and this revealed a purulent effusion. *A meyeri* was identified after culture of the pleural effusion. Despite treatment with intravenous penicillin (20 Mio IU/d), a loculated pleural effusion developed. Chest computed tomography (CT) demonstrated thickening and enhancement of the parietal pleura and confirmed loculation of pleural effusion and left lower lobe atelectasis (Figure 2). Bronchial carcinoma was excluded by means of bronchoscopy and transbronchial biopsy of the left lower lobe. Pulmonary function testing revealed moderated obstruction and an important restriction, with a forced expiratory volume in 1 second of 1.04 L (47% of predicted value), a forced vital capacity of 1.72 L (66% of predicted value), and a total lung capacity of 3.58 L (72% of predicted value). The patient remained febrile without clinical improvement and complained of pain at the site of previous drainage. A stage III empyema was diagnosed, and an operation was performed.

At thoracotomy, we found a pleurosubcutaneous fistula at the site of thoracic drainage mimicking an empyema necessitatis. The parietal and visceral pleura were thickened and adherent to adjacent structures, as usually seen in advanced mesothelioma. Decortication was performed with resection of the sinus tract, including the sixth rib and its interspace. Microbiologic examination of the pleura was performed, and *A meyeri* was found in the pleural loculations filled with putrid liquid. The patient presented no postoperative complication and was discharged after 16 days. An oral penicillin regimen was prescribed for 6 months. Clinical and radiologic evolutions were favorable, with minimal pleural sequellae on chest radiography. Functional evaluation at 6 months after the operation revealed a forced expiratory volume in 1 second of

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